1.2 Direction Fields

Let us model the altitude of a boulder thrown by a catapult!

1. Which basic Physics principle should we use?

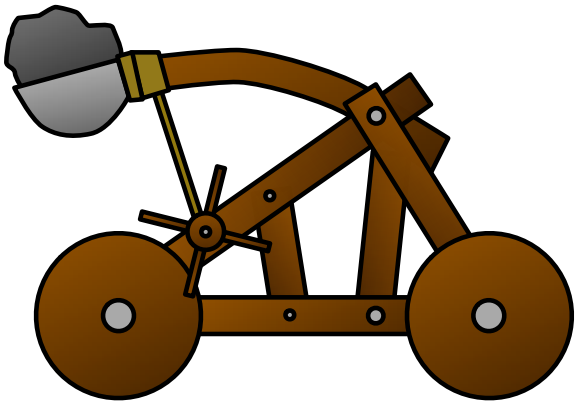
   a. Conservation of Angular Momentum

   b. Newton's 2^{nd} Law

   c. Rate of Change = rate in − rate out

   d. Conservation of Linear Momentum

   e. Conservation of Energy

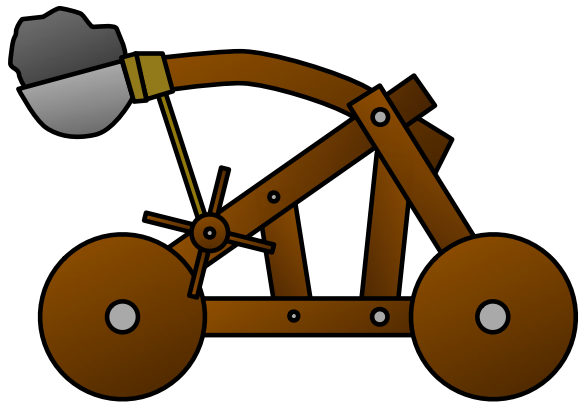


1.2 Direction Fields

We need to know:

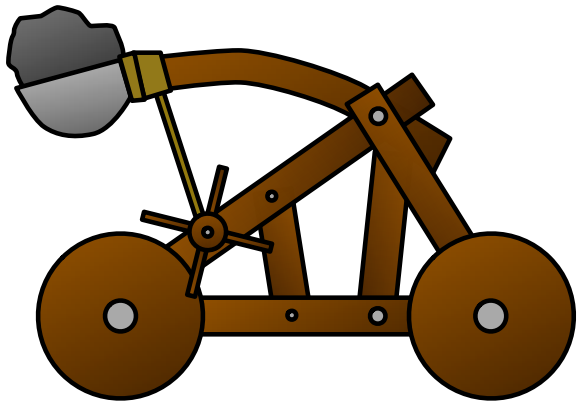
2. Acceleration =

3. Force =

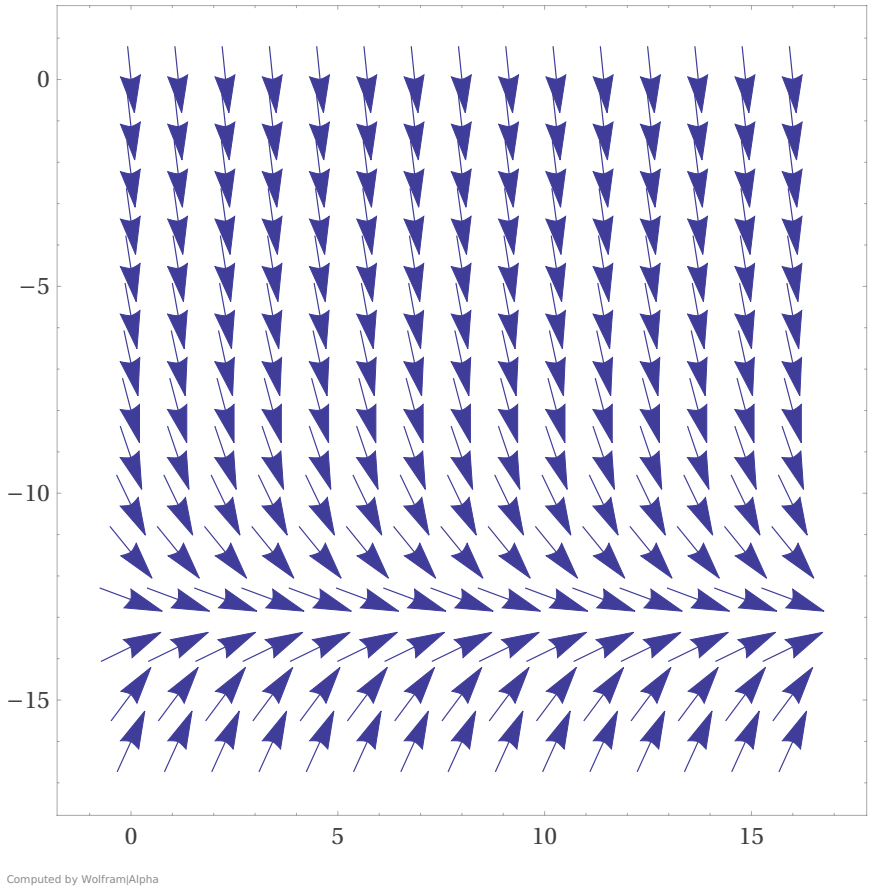


1.2 Direction Fields

4. What do we know about the boulder at $t = 0$?



1.2 Direction Fields



Direction field for

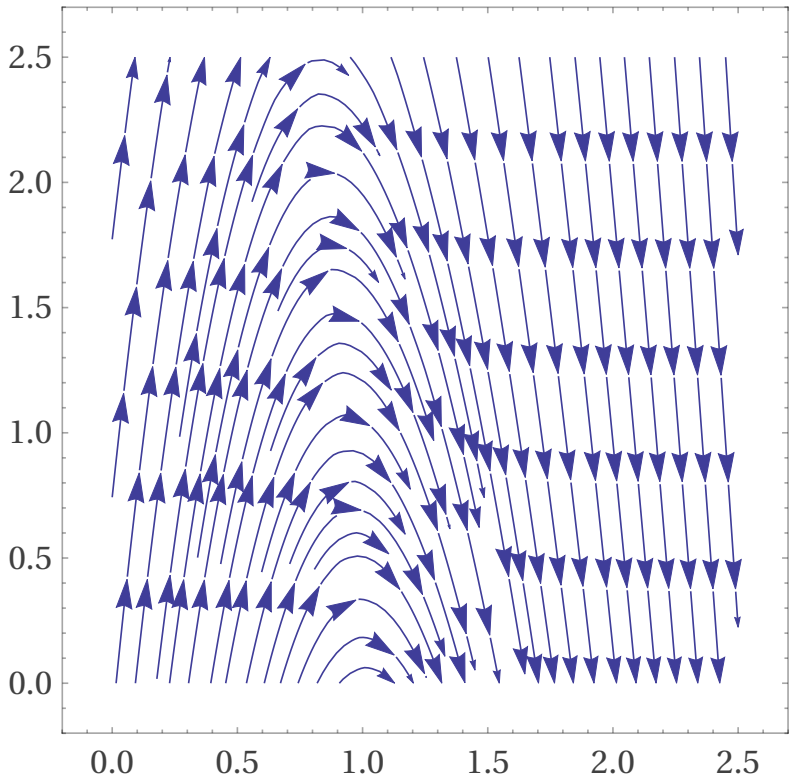
$$v'(t) = -g - \gamma v(t)$$

5. Label the axes.
6. What will happen to the object as time increases?
7. What do the horizontal arrows mean?

1.2 Direction Fields

$$v'(t) = -g - \gamma v(t) \qquad \text{with} \qquad v(0) = 10$$

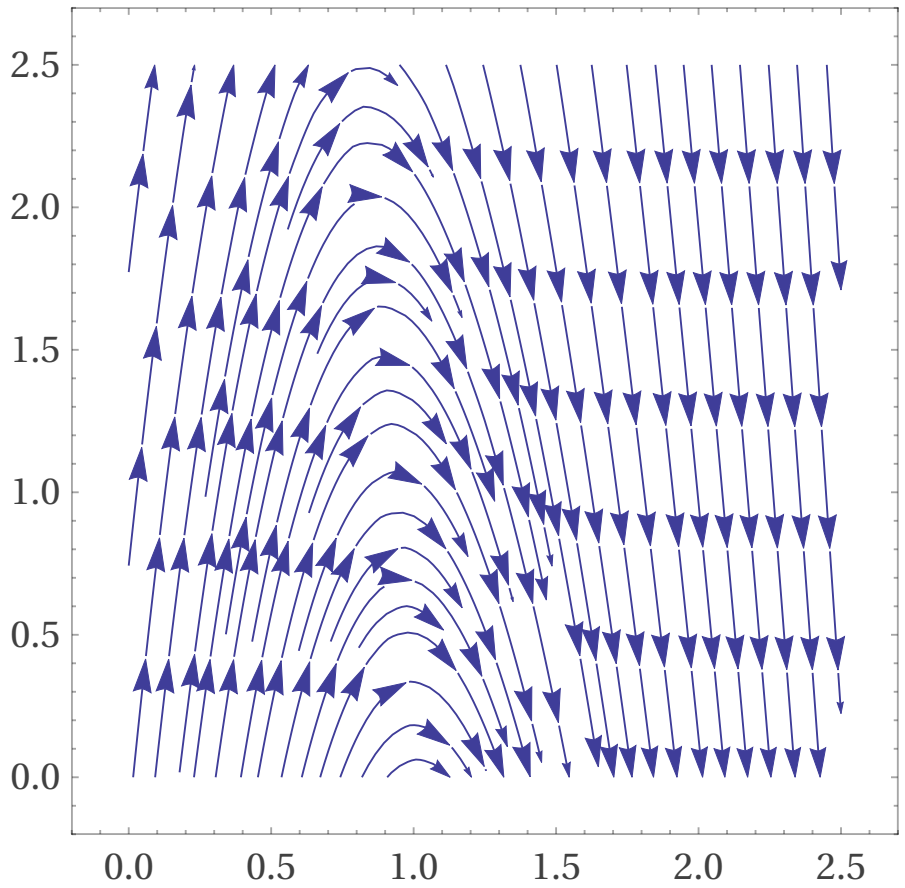
8. Integrate both sides. What do you obtain?




```
streamplot {1,-9.8*x-3*y/4+10} , x=0..2.5 , y=0..2.5
```

1.2 Direction Fields

$$v'(t) = -g - \gamma v(t) \qquad \text{with} \qquad v(0) = 10$$



9 Does the path of the boulder form a parabola? Why?

Preparation for next lecture

2.3 Modelling with ODEs

- Watch https://youtu.be/njg8xwMviGQ